Space Weather Technical Forecast

Issued on Monday, 28 November 2022 at 01:22 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Increasing Chance of Minor Geomagnetic Storm (G1) intervals through the period. Chance of Active electron fluence each day.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Very Low in the past 24 hours, with no discernible flares. There are currently four sunspots on the Earth-facing disk, all of which are small, simple and apparently stable. No new Earth-directed CMEs have been observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar wind parameters, as measured by ACE and DSCOVR at L1, were indicative of positive coronal hole HSS influences, perhaps with a late arrival of an embedded CME. Solar wind speeds fell from 550 to around 420 km/s before rising erratically to around 500-550 km/s by the end of the period. Density was average or a little above. The interplanetary magnetic field, IMF Bt, rose from weak to moderate, peaking at 11nT at 27/2200 UTC. The north south component was weak for much of the period but became moderate with fluctuations between +9/-8 nT. The phi angle was mostly positive (away from the Sun). Geomagnetic activity was largely Unsettled (Kp 3) with one Active (Kp 4) period late on 27th.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured at GOES16 has remained at Background levels. High energy electron flux (greater than 2MeV) at GOES16 was at Moderate levels before becoming high between 27/1345-1850 UTC. Electron fluence levels has been on a continued rising trend but has remained below the Active (1e8 integrated pfu) level. Observed fluence at 28/0000 UTC was 4.28e7 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain Low or Very Low, with a chance of isolated C-class flares.

Solar Wind / Geomagnetic Activity: The CME from 24th may arrive on day 1 or early day 2 (28th-29th). Earth is now assessed to currently be in the waning HSS of CH48/+. CH49/+ in the northern hemisphere is a recurrent feature, which is expected at Earth from day 2 (29 Nov), with speeds more typically around 500-550 km/s. CH51/+, with it's leading edge currently near the central meridian is also a recurring feature. With speeds likely around of 550-600 km/s, the HSS of this feature is expected to arrive at Earth either late on day 3 or more likely into day 4 (30th-1st).

Geomagnetic activity is expected to be mainly Quiet to Unsettled with Active intervals and a chance of G1/Minor storm intervals each day due to either CME or coronal hole HSS effects. This risk increases on day 4 due to the arrival of CH51/+.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) observed by GOES16 is expected to remain at Background levels throughout.

In coming days, flux levels may continue to reach High levels during the diurnal maxima,

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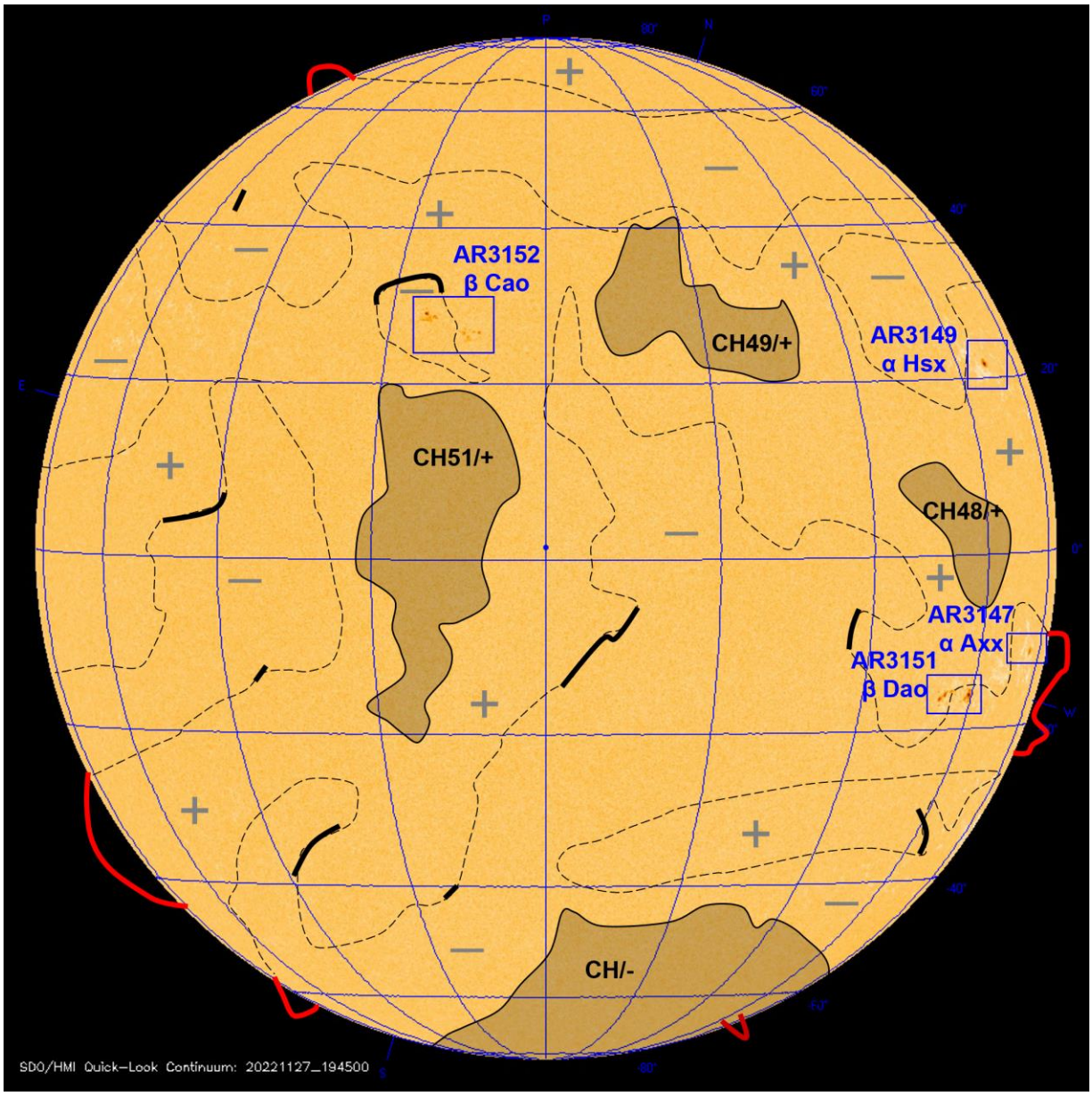
perhaps becoming high for prolonged periods, although the possible CME arrival on 28th or 29th, then coronal hole HSS influences on 29th and 1st may have the impact of knocking out electrons or compressing the electron field and curb any prolonged period of high flux. Fluence levels will continue to respond by increasing with a chance of reaching the 1e8 integrated electron fluence active threshold each day. Confidence wanes through the period due to the additional complications owing to CME and CH HSS arrivals during the period.

Figure 1. Solar Analysis Valid 27/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:

Several recent CMEs have occurred on, or close to the Earth-Sun line. There is greater than average uncertainty regarding the timings and impacts of these features however, given intermittent solar imagery and faint coronagraph signatures to fit analysis. On 24 Nov a two-stage filament eruption was observed from a region near the centre disc in the southern hemisphere. These both resulted in a faint CME signature on coronagraph imagery, however, analysis of the CME(s) was very difficult, with significant imagery gaps compounding the faint CME trace. An Earth-directed component is expected, however, confidence in timings and effects are low and the CME could arrive on day 1 or early day 2 (28th-29th).

Earth is now assessed to currently be in the waning HSS of CH48/+. CH49/+ in the northern hemisphere is a recurrent feature, which is expected at Earth from day 2 (29 Nov), with speeds more typically around 500-550 km/s. CH51/+, with it's leading edge currently near the central meridian is also a recurring feature. With speeds of 550-600 km/s, the HSS of this feature is expected to arrive at earth either late on day 3 or more likely into day 4 (30th-1st).

Geomagnetic activity is expected to be mainly Quiet to Unsettled with Active intervals and a chance of G1/Minor storm intervals each day due to either CME or coronal hole HSS effects. This risk increases on day 4 due to the arrival of CH51/+.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	30	30	40
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
25/1904	Partial	Filament	S Hemisphere Centre Disk	630	28/000-29/000	Low confidence

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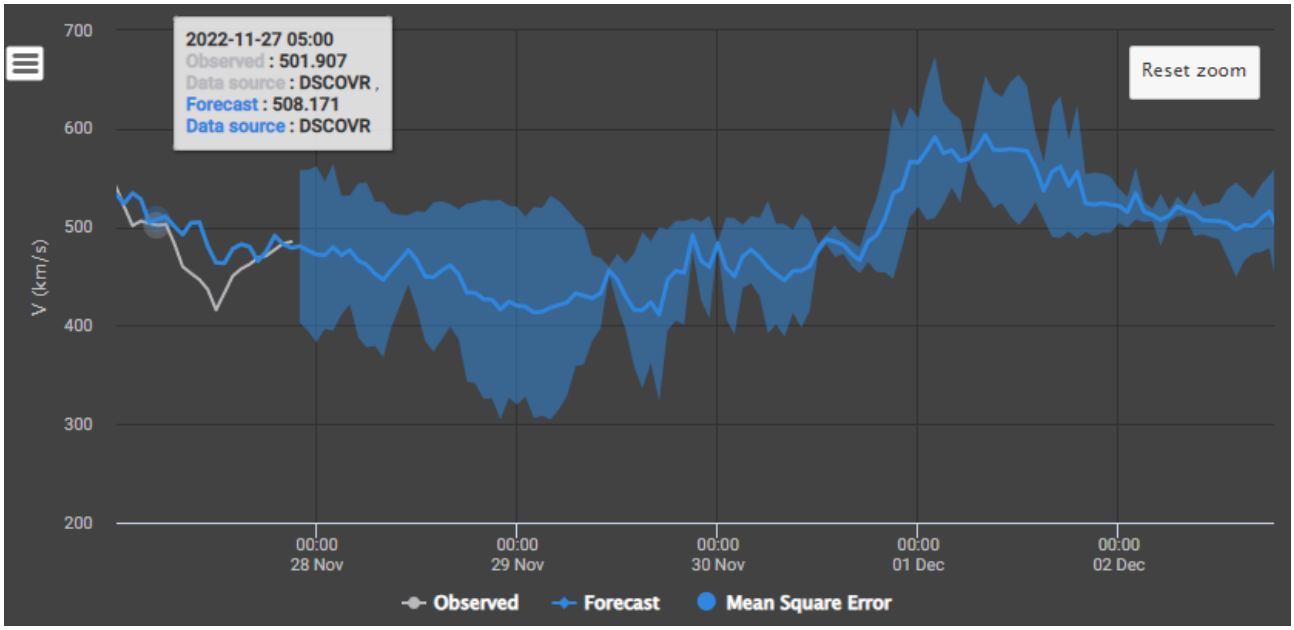
Figure 2: MOSWOC SWPM persistence model.



Radio Blackouts - X-Ray Flares:

Solar activity is forecast to remain Low or Very Low over the four-day period with all of the current four numbered Earth-facing sunspots small, simple and apparently stable. Three of the regions are transiting toward the western limb, with the other region located in the northeast quadrant.

Meanwhile, on the eastern horizon, the Carrington locations for several far sided regions should arrive at the eastern limb from 28 Nov (Day 2). This results in an overall level trend through the four days as none of the upcoming sunspot groups has shown inferred significant flare or CME activity from coronagraph imagery.

Overall there is a chance of further isolated C-class flares, with a very slight chance of isolated M-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) at GEO, as observed by GOES16 is currently at background levels and is expected to remain at this level throughout.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) observed by GOES16 has been at mainly moderate to high levels recently. In coming days, flux levels may continue to reach High levels during the diurnal maxima, perhaps becoming high for prolonged periods, although the possible CME arrival on 28th or 29th, then coronal hole HSS influences on 29th and 1st may have the impact of knocking out electrons or compressing the electron field and curb any prolonged period of high flux.

Fluence levels will continue to respond by increasing with a chance of reaching the 1e8 integrated electron fluence active threshold each day. Confidence wanes through the period due to the additional complications owing to CME and CH HSS arrivals during the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	40	40	30	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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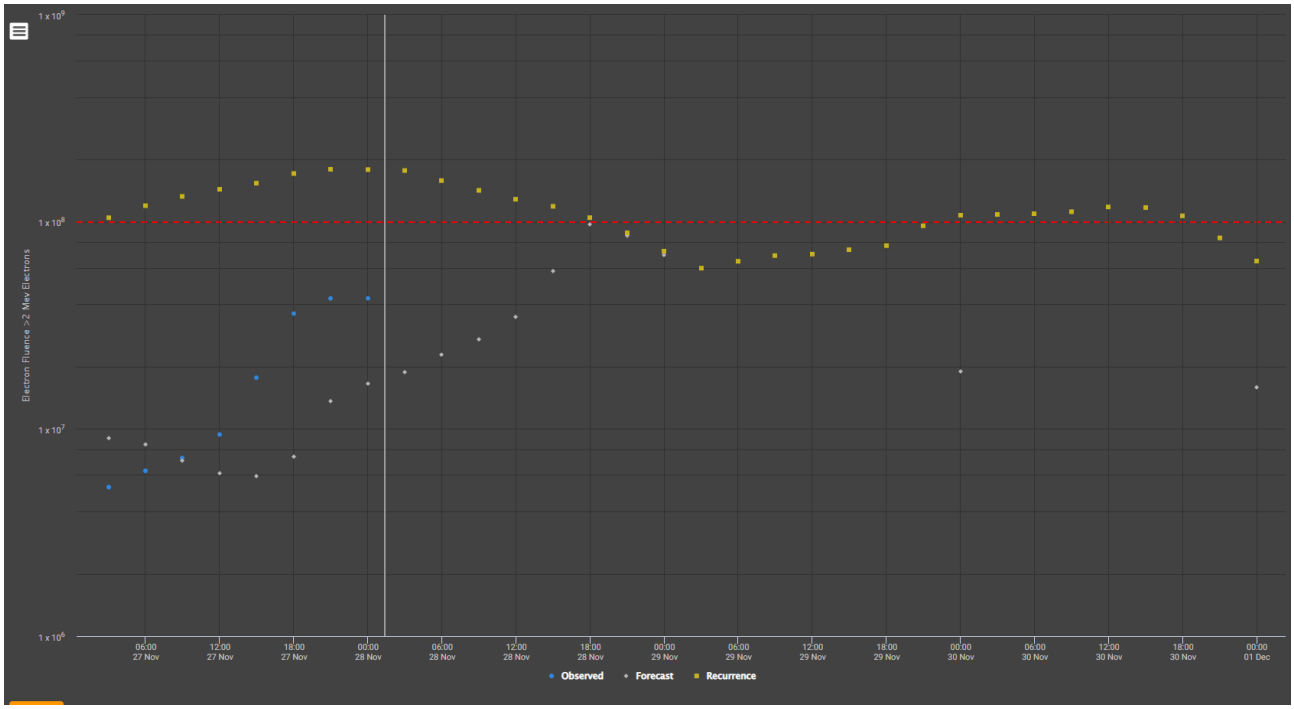
Figure 5: REFM integrate flux/fluence observations, persistence and model.



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